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U. S. DEPARTMENT OF AGRICULTURE
RURAL ELECTRIFICATION ADMINISTRATION

MANUAL FOR INSPECTORS

ENGINEERING AND OPERATIONS DIVISION
ENGINEERING SECTION

WASHINGTON
July 31, 1940

MANUAL FOR INSPECTORS

Preface

This manual is to be used as a general guide for inspectors making final inspection and inventory of REA projects.

In checking construction the inspector has only the responsibility of determining whether or not the construction is in accordance with the specifications and of so reporting conditions that proper action can be taken. This manual is for the purpose of assisting the inspector to judge whether or not the construction is acceptable under the intent and terms of the specifications. It also sets forth the procedure which the inspector is expected to follow in performing the inventory and inspection work.

Guy W. Thaxton
Chief Construction Engineer

INSPECTOR'S RELATIONS TO THE BORROWER

The inspector, although selected by REA for a particular project, is fundamentally an employee of the borrower and, as such, is expected to work in close cooperation with the borrower. Since living expenses are reimbursed by the borrower on an actual expense basis, the inspector shall, in presenting his bill, show in reasonable detail the moneys expended. With this in mind, a form of mileage and expense report is attached and all inspectors will be expected to use this form unless the regional engineer advises differently. Before beginning an inspection, the inspector should check with the project superintendent and learn in what detail the borrower expects him to itemize his expenses, but it should not be in less detail than indicated by the attached form.

If the inspector remains in the same region, travel expenses are allowed from one project to another. The borrower will pay the inspector's travel expenses from the last project on which he worked.

If, due to illness or other valid reasons, the inspector finds it necessary to take time off during an inspection, the borrower is not expected to reimburse the inspector's expenses during this period.

The borrower is to reimburse the inspector's living expenses only when the inspector is on the project and working. If the inspector is working on the project six days a week, it is proper for him to include his living expenses for Sunday in the bill, but if he takes time off for personal reasons, the borrower is not obligated to pay his expenses during that time. Although a maximum of $30 per week is permissible, the expense account is to be in detail and reflect actual expenditure.

INSPECTOR'S RELATIONSHIP TO REA

The inspector, although working for the borrower, is under the general supervision of the REA field engineer, who gives him instructions and assignments. The inspector shall submit a report to the field engineer, giving the results of his inspection and inventory check. The field engineer shall be consulted regarding any controversial items and the inspector shall not order alterations unless the work is definitely a violation of the Plans and Specifications. Certain instructions with respect to interpretation of the Plans and Specifications will be found in this manual.

The inspector is expected to certify to the correctness of the inventory and the method of doing so is described under the heading of "Inventory".

GENERAL INSTRUCTIONS REGARDING INSPECTION AND INVENTORY CHECK

(Specific instructions in Eng. Memo. #58)

Before starting the field inspection the inspector must check the particular construction contract applying to the project to be inspected since, due to local conditions, it may vary somewhat from the standard form. It is also very important that the inspector check the lines constructed against the approved Plans and Specifications to determine that all of the lines constructed have been approved, either in the original construction contract or in approved amendments.

The inspector shall determine how much and what portion of the system will be inspected; however, he shall inspect any or all of the lines if the field engineer so directs.

It is the inspector's duty to make an impartial inspection of the construction done under the contract. He shall keep free of biased influence in considering

all matters. He shall report conditions as he finds them to the REA field engineer, giving his comments regarding the necessity or desirability of correcting faulty work, keeping in mind that when alterations from the existing construction are required, the result should be a more desirable condition.

The inspector will be asked to certify to the accuracy of the staking sheets and the staking sheet recap. In order to be able to do this, the inspector should make his field check on the following basis:

The project engineer's staking sheets should be checked in detail on the lines that are inspected in the field. Any differences found during the field check should be noted on the staking sheets with red pencil and all sheets checked should be initialed in ink by the inspector, the project engineer and the contractor's representative. Changes on other documents shall also be initialed by these men. The field engineer will advise the inspector what percentage of the lines will be measured span by span, but in general enough spans should be checked so that the inspector can certify that the engineer's figures are substantially correct.

Not less than 25 percent of the lines will be inspected and in general if, after checking this amount, no errors or very few errors are found, the inspector shall notify the field engineer accordingly and instructions will be given regarding continuing the inspection. This applies to both the inspection of construction and checking of inventory. If a 100 percent check is made, it shall be made with the same accuracy as the first 25 percent. If, however, after checking approximately 10 percent of the system or the inventory, the work is found to require a large amount of correction, the inspector shall so notify the REA field engineer or regional engineer (as the regional engineer for that region may require), who will instruct the inspector as to his procedure. Inspection is not to be continued without the approval of the field engineer or the regional engineer, as the case may be.

Field inspection and inventory check can and should be made simultaneously and the inventory checked on all lines inspected. In reporting errors in construction, the inspector shall prepare a list of items which are not in accordance with the intent of the specifications. Copies of this list shall be furnished to the contractor, project engineer, cooperative, and REA field engineer. In the event the list covers items of controversial nature, all of such items are to be referred to the field engineer for decision. It is expected that the contractor will start corrective work immediately and normally complete it before the inspector leaves the project.

After the field check is completed, it is the duty of the inspector to check the recap of the staking sheets against the corrected staking sheets and note any errors which may have occurred in preparing the recap of the sheets. The inspector should make a check of the recap in accordance with instructions in Engineering Memo #58, since he will be required to certify that the recap of the staking sheets is accurate. A form of certification for construction and inventory check is attached to this manual and should be used by the inspector in making his certificate unless directed otherwise by the regional engineer. REA has certain limitations regarding the length of extensions which may be built on private property with the use of REA funds. These limitations may vary for different projects and the inspector shall therefore ascertain what applies to the particular project under inspection. He shall see that the inventory fully reflects the conditions as he finds them.

DISCUSSION OF INSPECTION

The following pages deal with methods of inspection and procedure to be followed. Certain interpretations of the specifications are given to clarify the intent set forth therein. This manual is prepared with specific reference to REA specifications issued August 29, 1939. Any variation of the particular project specifications should be taken into account in applying this manual. Any variation from the exact requirements of the specifications must be very limited. The allowance of any variation is for the purpose of eliminating costly corrective work if the over-all performance is satisfactory.

The inspection of the system and the check of the inventory is one of the final steps in closing out the project construction. The inspection should therefore report any matters which may delay completion. This may include reporting of unsettled labor claims, pending law suits and use of unauthorized subcontracts.

I - POLES

a. Depth of Set.

The center line of the brand shall be considered as exactly 10 feet above the butt, unless the project engineer certified otherwise in writing, prior to the setting of the poles.
A representative number of poles shall be checked in regard to depth of setting. The number of the pole, and the amount the depth of setting varies from the specifications shall be reported.

b. Alignment.

Poles shall be in alignment within 1/2 of ground line diameter of pole (for tangent poles) unless they are raked to take care of side strain (for example, service take-off).

c. Raking.

1/2 inch per foot of pole is desirable rake. A variation of 6 inches either way in total length of pole may be permitted so long as conductor is not pulled out of alignment to an unsightly degree. In such cases the matter shall be reported.

d. Pole Framing.

Neutral supports on tangent poles shall be installed so that the conductor fits smoothly into the groove of the insulator and so that neither the tie wire nor the conductor bind against the edge of the groove. Crossarms for two and three phase tangent assemblies are to be perpendicular to the line conductor. Double pin assemblies, i.e., A2, B2 and C2 are to bisect the angle so that the conductor strain is transmitted to each pin equally. See Figure No. 1.

e. Backfilling and Tamping.

A reasonable number of poles shall be checked for proper backfilling and tamping. All poles must be banked with earth and soil shall not have been borrowed in such a manner as to leave a hazardous pit. The amount of banking of earth around the poles shall be observed and any poles not reasonably banked shall be reported.

II - POLE TOP PINS

Pole top pins shall be installed with the flat side toward the pole and on alternate sides in a line of poles.

III - ANCHORS

a. Depth of Setting.

Report any conditions which indicate that the depth of anchor setting varies more than 4 inches from that shown in the specifications. In no case shall the anchor eye be underground, or the guy strand in contact with earth.

Report any conditions which might justify the existing variation.

b. Alignment.

Anchor rods must be in line with the strain of the guys.

c. Bisecting of Angles.

Any anchor locations which do not bisect the angle of the line or are not in line with the center of strain shall be reported, giving the distance which the anchor is off line and the lead of the guy. Present any data which might justify leaving anchor in such position.

d. General.

A representative number of anchors shall be checked to determine that they are properly undercut in case logs are used, or properly expanded if patent expansion type anchors are used. The REA field engineer will advise the inspector regarding the number of anchors to be tested and the method to be used. The earth shall have been properly tamped and backfilled on all anchor installations.

IV - GUYS

a. Guys shall be tight. All bolts of the three-bolt clamp are to be tight.

b. Guy Clamps must fit properly and with sufficient distance between the clamp and the anchor eye to not adversely strain the guy strand. (Minimum distance 5").

c. Guy tails shall be neatly served with no sharp ends of guy strand projecting. (Provision shall be made to insure a positive electrical contact at all times between the guy strand and the anchor rod if the specifications require this connection.)

d. Guys are to be bonded to the neutral in accordance with Engineering Memorandum No. 77.

V - RIGHT-OF-WAY CLEARING

a. The inspector shall check carefully to see that all brush and other refuse is removed from the right-of-way and is properly disposed of or destroyed. It shall not be left where it will be visible from roadways nor where it will endanger the line if burned.

b. If the inspector finds brush not properly disposed of, it shall not be burned so close to the line that the poles or conductors are endangered. The inspector should watch for signs of the conductor being "smoked" which would indicate that brush had been previously burned under the line. Each such case must be reported.

c. The inspector should report all trees felled but not cut to commercial wood lengths, as specified by the project engineer. Logs left carelessly scattered, either on or off of the right-of-way shall be reported.

d. Any controversies with property owners, over right-of-way trimming or clearing shall be reported.

VI - TREE TRIMMING

Trees not trimmed according to specifications, or which do not provide the six foot clearance required by the specifications, shall be listed on the report, with the inspector's recommendation. In making this report the inspector should keep in mind the possibility of someone contacting the line while climbing the tree, also he should consider the actual possibility of the surrounding branches contacting the line. Report any inferior workmanship done in the trimming of trees.

VII - GROUNDS

a. Ground rods shall be installed a minimum of 24 inches from the pole and the top of the rod shall be a minimum of 12 inches below the ground. These are minimum figures and no variation is permitted unless authorized prior to installation by the engineer in writing in any special case.

b. Ground rods must be driven and not placed in augured or bored holes.

c. Ground rod clamps must be tight.

d. The butt coils of coil type ground are to conform exactly to the specifications with respect to the minimum number of turns and the short circuiting turn.

e. Ground wires are to be continuous to the neutral and not spliced.

f. The inspector should check the staples on the ground wire to see that the size, number and location meet the specifications.

g. Ground wires are not to be placed in the climbing space on any pole. (See transformer and cutout sections, this manual.) This is very important.

VIII - HARDWARE

The inspector should make a general check of all hardware to determine whether or not it meets specifications. He should make a visual inspection of the galvanizing on a representative amount of each item of hardware.

The inspector shall include observation as to whether or not hardware is installed in accordance with specifications. Particular attention is called to the fact that bolts are not to protrude past the outside face of the nut more than 1-1/2 inches. No bolts are to be cut off. If they are too long they shall be replaced, if they constitute any hazard to a lineman.

IX - TRANSFORMERS

a. Mounting of Transformers.

The installation of transformers must satisfy two fundamental requirements:

1. The maintenance of proper climbing space, and accessibility to primary cutout or hot line clamp.
2. The maintenance of proper and safe clearances.

The principles of the drawings in the REA specifications can be applied to all installations. For purposes of illustration, four drawings are shown as follows:

Fig. No. 2 - CONVENTIONAL TRANSFORMER-TANGENT INSTALLATION.
Fig. No. 3 - CONVENTIONAL TRANSFORMER-DEADEND INSTALLATION.
Fig. No. 4 - COMPLETELY SELF-PROTECTING TRANSFORMER-TANGENT INSTALLATION.
Fig. No. 5 - COMPLETELY SELF-PROTECTING TRANSFORMERS - DEAD-END INSTALLATION.

Referring to these drawings, the following fundamentals are observed:

1. In the case of the tangent installations, the neutral conductor should always be placed on the same side of the pole as the member to be served. If the neutral is not being carried on that side of the pole normally, it should be switched to that side on the transformer pole.

2. In the case of tangent construction the transformer should be installed on the opposite side of the pole from the neutral conductor, with the secondary bushings facing the neutral conductor. On dead-end structures and on tangent structures special care should be given to see that the secondary bushings and the transformer tank clear the conductors properly.

3. On tangent installations the transformer angle is to be a minimum of 30° if no secondary dead-end is involved. If a secondary dead-end is involved, this angle must be sufficient to give a 3" clearance from the secondary bushings or transformer case to the secondary conductor.

4. If more than one service is installed on a pole the same principles apply as above described, although variations may be necessary.

5. The crossarm supporting the lightning arrester and cutout should be installed at an angle of 45° plus or minus 5° variation, as shown in the drawings for conventional transformers.

6. The quadrant which the cutout faces is to be left entirely free for climbing space.

7. The ground wire is to be located on the pole in the quadrant between the transformer and the neutral support, leaving the climbing space entirely free.

b. Transformer Connections.

Transformers are to be connected as shown schematically in Figures Nos. 6 and 7 illustrating the conventional and CSP type respectively. Note the fact that one less connector is required to connect the transformer

ground wire for installations on dead-end structures than on tangent structures. The following fundamentals are observed:

1. The ground wire is to be continuous to the neutral.

2. The connection between the pole ground, case ground, neutral bushing and neutral conductor should be continuous.

3. The middle bushing of the transformer is always made neutral regardless of whether two or three-wire service is taken off the transformers.

4. Where a two-wire service only is taken off the transformer, the secdary windings of the transformer must be connected in parallel.

5. On completely self-protected transformers, deion gaps must be set at the manufacturer's recommended setting. The inspector should equip himself with a guage of exact width and measure a representative number of gaps. The setting of the gaps on double gap arresters when used, should be checked similarly.

6. Primary transformer leads are to be made of soft-drawn bare copper of No. 6 conductivity.

X - SERVICES

a. Services shall not be spliced or sleeved.

b. Services shall be sagged with limits of 0" high to 6" low (unless clearance is unsatisfactory) in accordance with the sag tables in the standard REA specifications.

c. Wireholders on the pole shall be lined up with the direction of the service pull and also at the house, if possible.

d. Enough wire shall be left at the line pole to make connection to the secondary and neutral without splicing. Enough wire shall be left at the house to connect to the service entrance without splicing. The jumpers at the entrance cable shall be arranged so that there will be no chance of the connectors contacting each other and causing a secondary short.

e. The neutral service wire is always on top and connects directly to the neutral conductor, not the neutral bushing of the transformer.

XI - CUTOUTS, HOT LINE CLAMPS

a. Cutouts when installed should follow the general principles outlined as follows:

1. Cutouts on single-phase lines at sectionalizing points should be mounted on crossarms at an angle of 30° plus or minut 5°.

2. The lead from the supply side of the line should be connected to the top of the cutout.

3. The hot lead should be the shortest lead (i.e. when the switch or cutout is open the lead on the source side still remains hot). If this is not possible, then the hot lead must be carried well above the reach of the lineman. See Figures Nos. 8 and 9.

b. Hot line clamps.

1. Hot line clamps are to be installed so that the jumper is de-energized when the clamp is disconnected. See Figure No. 10. The details of hot line clamp installation will be discussed under the heading of conductor. In no case shall they be installed in spans crossing over other lines or railroads.

XII - CONDUCTOR

a. Sagging.

In accordance with Engineering Memorandum No. 84, REA requires that the project engineer check all conductor sag shortly after the conductor is sagged. Written certification of inspection is required of the engineer whose records are available to the inspector at the time of his inspection. The inspector shall examine these records and make certain from these that all conductors have been checked.

Any obvious errors should be checked by the inspector in the field and results included in the inspector's report.

Any relevant information, such as conductor loading that might have a bearing on the present sag condition, should be reported by the inspector.

b. Connectors.

Solderless connectors shall not be installed in spans crossing over other lines or railroads.

c. Sleeves.

Conductor sleeves are to be checked for the following conditions:

1. To ascertain that the correct size sleeve as recommended by the manufacturer is used.

2. To ascertain that the exact number of twists are used, as recommended by the manufacturer.

3. No sleeves are permitted in railroad, major highway, or major telephone crossings, or any crossings requiring an increased grade of construction.

4. No sleeves are closer than 3 feet to poles.

5. Where stranded conductor is used, the sleeves are to be twisted so that the helix axis of the sleeve is opposite to the lay of the conductor strand. Refer to REA Specifications Drawings Nos. M45-1, and M45-10, reprinted in this manual as Figs. No. 11 and 12.

d. Conductor Dead-ends.

REA specifications for conductor dead-ends are clearly shown in REA Specifications Drawings Nos. M42-1, M42-2, M42-3, M42-10. Careful study of these drawings is required of the inspector. They are reprinted in this manual as Figs. No. 13, 14, 15 and 16.

Referring to Fig. No. 13 showing the connector type dead-end for solid copper conductors, the following points are emphasized:

1. The three connector spacing of 7" - 2" - 18" for No. 6 copper and 7" - 2" - 20" for No. 4 copper are to be strictly followed. This is important from vibration standpoint. Any appreciable variations shall be reported.

2. On the second and third connectors the tension conductor is to be placed between the conductor tail and the shim on the lower side to prevent nicking of the tension conductor. This is important.

3. Between second and third connectors, the conductor tail is to be wrapped around the tension conductor three times.

4. The middle connector should be used to make connections, the connecting wire replacing the shim required under this connector.

5. The dead-end thimble must be installed properly to avoid placing a sharp bend in the conductor. See Figure No. 17. Edges do not cut into conductor.

Referring to Figure No. 14 for copperweld copper and stranded copper conductors, the following points are emphasized.

1. As in the case of the solid copper dead-end connector spacings are to be as specified.

2. After the first connector the conductor tail is wrapped around the tension conductor with the lay of the strand of tension conuuctor.

3. In place of the third connector, the conductors are unwoven at the proper location, one conductor being carried through and served around the tension wire by six times. In the case of copper-copperweld conductors, the copperweld strand is the strand carried through, the other conductors being used as the serve.

4. The same principle shown in Figure No. 17 applied regarding the position of the dead-end thimble.

Referring now to Fig. No. 15 which gives an alternate method of dead-ending copperweld copper and stranded copper conductors, the following points are emphasized:

1. The secondary dead-end is made exactly the same as in the previous method.

2. The primary dead-end clamp replaces the connector type dead-end on the primary and neutral.

3. The conductor tail is to be bent away from the tension conductor sufficient to avoid chafing.

4. In general the clamp should be faced parallel to the direction of the jumper lead take-off.

Referring to Fig. 16 for the dead-ending of ACSR conductors, the following points are emphasized:

1. The conductor clips are spaced 7" from the mouth of the dead-end thimble and 6" thereon. These spacings are expected to be as specified. Report any appreciable conditions to the contrary.

2. The same principle regarding position of dead-end thimble as illustrated in Figure No. 17 applies here.

3. Armor tape is to be wrapped evenly and tightly around the conductor two turns beyond the mouth of the thimble.

e. Ties.

Conductor ties must conform to the manufacturer's recommendations as reprinted in the REA Specifications. See REA Drawings Nos. M40-1 and M40-10, reprinted here as Figures Nos. 18 and 19.

The inspector is cautioned to check the following items with respect to ties:

1. Ties must be made of the proper size tie wire as recommended by the manufacturer.

2. Ties must be tight.

3. Excessive loose ends on ties are not to be accepted. They must be cut off or folded back as in the specifications.

4. In no case shall a tie pull the conductor from its straight line position.

f. Taps - Hot Line Clamps.

Referring to REA Specifications Drawing M43-1 and M43-2, reprinted here as Figs. No. 20 and 21 governing taps on solid copper conductors and for copperweld-copper and stranded copper, the following principles are observed:

1. Hot line clamps are always installed over a bridle loop, whether the clamp is installed on a tangent or dead-end assembly.

2. Jumpers shall have sufficient slack to permit removal of clamps without difficulty.

3. Neutral and secondary taps from tangent poles are made by connectors with the tension conductor passing in the center of the tap wire and the end of the tie wire to avoid nicking the conductor.

Referring to REA Specification Drawing M43-10, reprinted here as Figure No. 22, governing taps off ACSR lines, the following is observed:

1. Bridles are used to support hot line clamps off dead-ends whereas hot line clamps installed on tangent line are installed over the armor rods.

2. Extra length armor rods are used off center where hot line clamps are installed on tangent poles. The rod extends 20" on one side of the pole top insulator and 32" to the side on which the clamp is installed.

3. Connections at dead-ends made with connectors are made between the mouth of the thimble, or the secondary spool, and the first conductor clip.

4. All connections on tangent poles made with connectors are made over the armor rods 5" from the end of the rod.

g. Armor Rods.

On ACSR projects the inspector's attention is called to the details of armor rodding as follows:

1. Rods are twisted so that they follow the lay of the strand of the conductor.

2. Rods are to be snug, not loose or tight and bulged. The lay of their strand should approximately parallel that of the conductor. Particular attention to this is to be paid on angle installations.

3. Armor rod clips for No. 4 ACSR will be approximately 1.5 - 1.75" from the end of the rods. The ends of the rods are to be flared.

XIII - RADIO INTERFERENCE CHECK

Engineering Memorandum No. 82 describes the procedure to be followed in checking to ascertain whether or not the line is constructed so as to cause unnecessary radio interference when energized. The inspector shall report the extent of his check in accordance with this memorandum and shall report the conditions which he finds.

XIV - NATIONAL ELECTRICAL SAFETY CODE AND STATE REQUIREMENTS

Proper attention shall be given to the checking of construction to determine that the requirements of the National Electrical Safety Code and State requirements have been met. Any infringements shall be reported. Particular attention should be given to conflict with existing utilities. Report any telephone lines that should be moved to properly meet requirements.

XV - SUBSTATION

The substation construction shall be checked to ascertain that the structure meets the specifications and is safe for operation. This should include a check of clearances between live parts and parts of the structure, and also clearances to other live parts. Minimum distances of live parts to ground level should also be checked.

XVI - FUSES

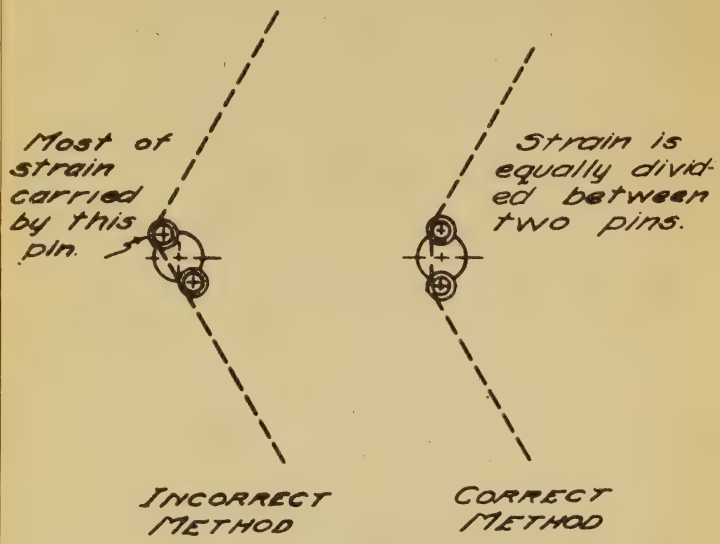
A spot check of the fuses installed in transformer installations should be made, the inspector satisfying himself that the fuses are sized according to REA recommendations.

The inspector should also check the size of primary and secondary substation fuses, making certain that fuses are as specified by the engineer. In the event that the engineer's recommendation appears to be inappropriate, he should communicate with the field engineer.

GENERAL

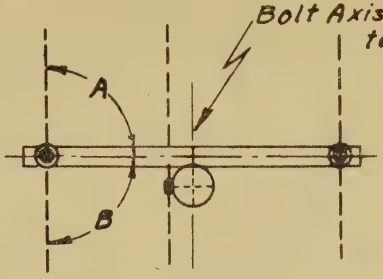
This manual is not intended to enumerate all of the items of construction which the inspector is expected to check. In the event the inspector views conditions that will tend to present hazardous operating conditions he should present all details to the field engineer as quickly as possible.

The inspector is invited to make any suggestions he may deem desirable for the improvement of this manual. From time to time it will be revised and each inspector is urged to keep his manual up to date. He should make note of any Engineering Memoranda which are issued which may alter the methods of construction.

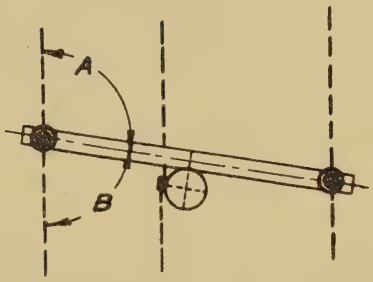


(Schematic Diagram)

FIG. NO. 1
PROPER POLE CANTING



CORRECT



INCORRECT

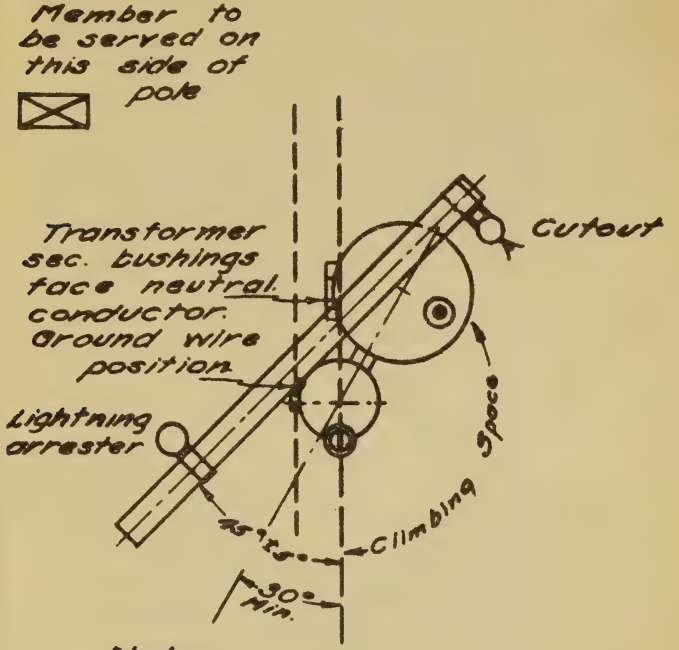
Notes:

① Angles "A" & "B" must be equal for both Tangent and Angle construction.

② Angles "A" & "B" must be 90° on Deadends.

FIG. 1-A

POLE CANTING (CROSSARM CONST.)



Note:
If service take-off is to right, install neutral on other side of pole and use same diagram, reversed 180°.

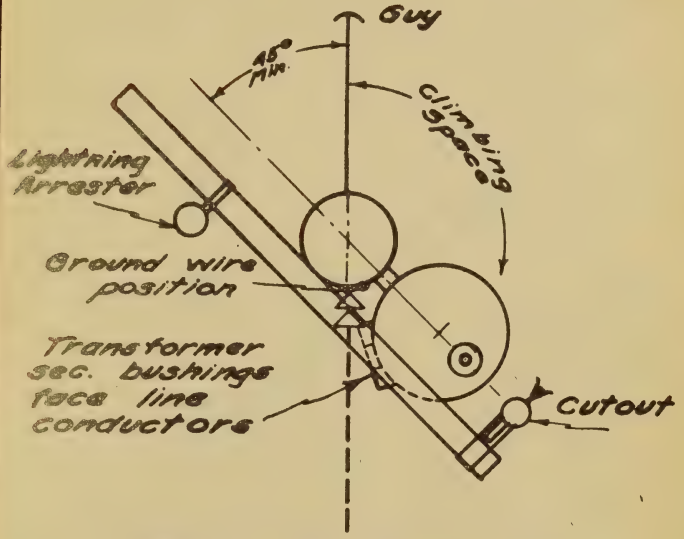
(Schematic Diagram)

FIG. NO. 2

CONVENTIONAL TRANSFORMER ON TANGENT POLE. SERVICE TAKE-OFF TO LEFT.

Note:
Increase angle where necessary to insure 3" min. clearance from trans case or secondary bushings to sec. conductors.

Member to be served on this side of pole.

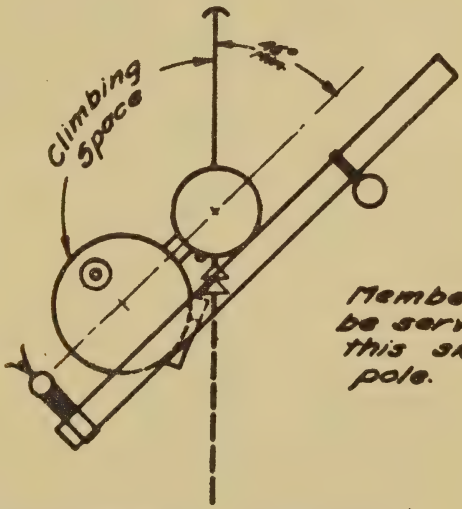


(Schematic Diagram)

FIG. NO. 3A.

CONVENTIONAL TRANSFORMER ON DEADEND POLE. SERVICE TAKE OFF TO LEFT OF POLE.

NOTE:
Same notes apply as used in Fig. No. 3A. This method meets all climbing and clearance requirements and makes possible shortest leads from secondary bushings to service wire attachments.



(Schematic Diagram)

FIG. No. 3B

CONVENTIONAL TRANSFORMER ON DEADEND POLE. SERVICE TAKE OFF TO RIGHT OF POLE

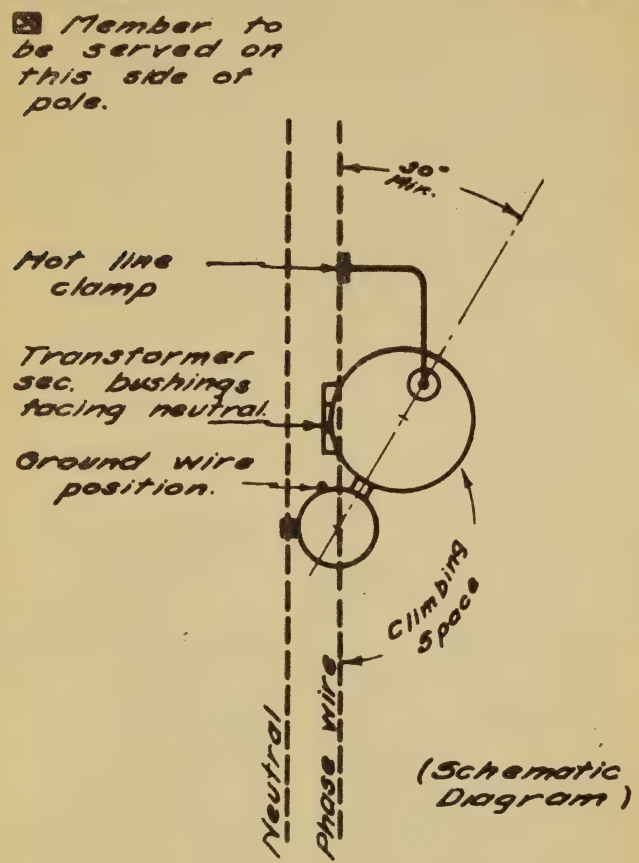
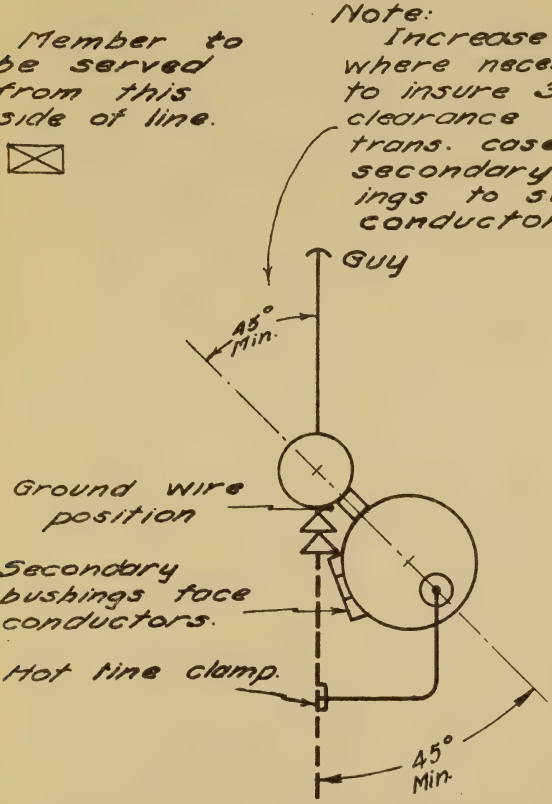


FIG. NO. 4.

COMPLETELY SELF-PROTECTING TRANSFORMER ON TANGENT POLE. SERVICE TAKE-OFF TO LEFT.



(Schematic Diagram)

FIG. NO. 5A

COMPLETELY SELF PROTECTING TRANSFORMER ON DEADEND POLE. SERVICE TAKE OFF TO LEFT.

Note:
Same notes apply as used in Fig. No. 5A. This method meets all climbing and clearance requirements and makes possible shortest leads from secondary bushings to service wire attachments.

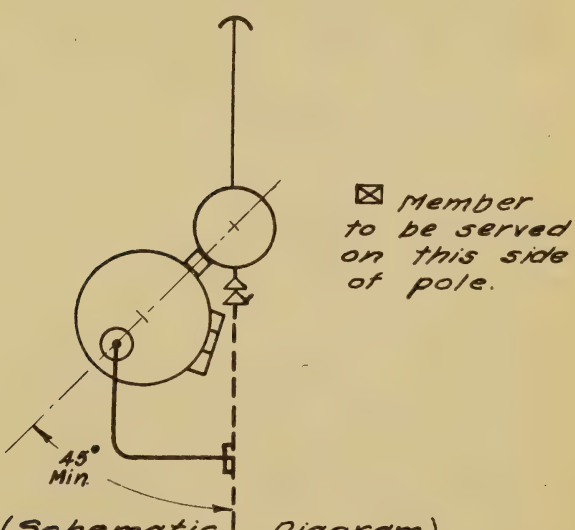
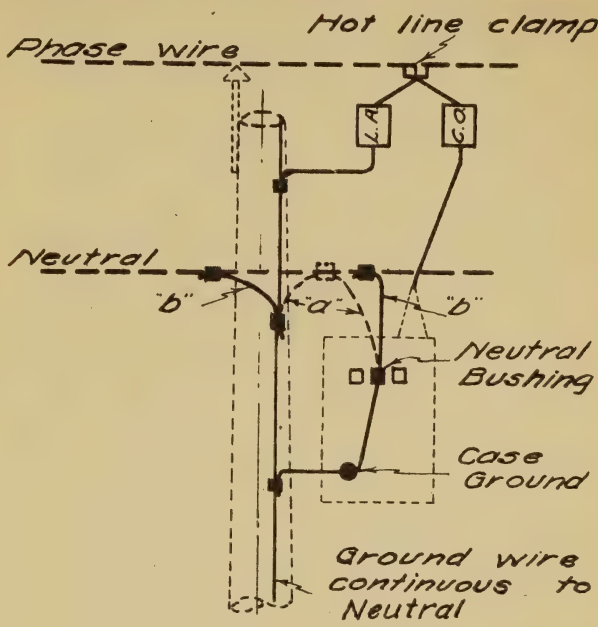


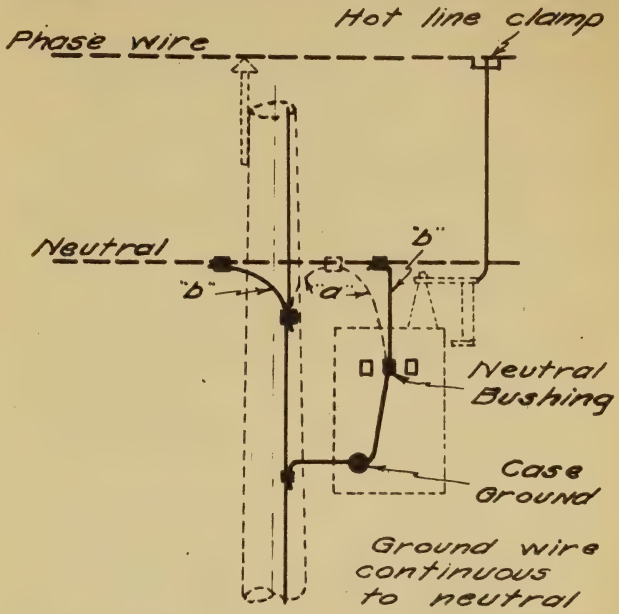
FIG. No. 5B.

COMPLETELY SELF-PROTECTING TRANSFORMER ON DEADEND POLE. SERVICE TAKE OFF TO RIGHT.



Note:
Use connections "b" for transformer at 30° angle with line.
Connections "a" are optional for 45° mounting.

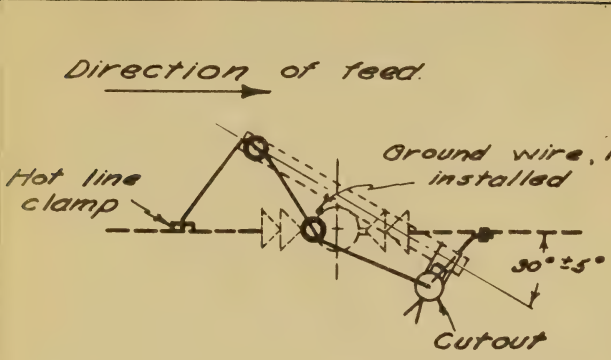
FIG. NO. 6
CONVENTIONAL TRANSFORMER SCHEMATIC DIAGRAM OF CONNECTIONS.



Notes on Fig. No. 6 apply to these connections.

FIG. No. 7

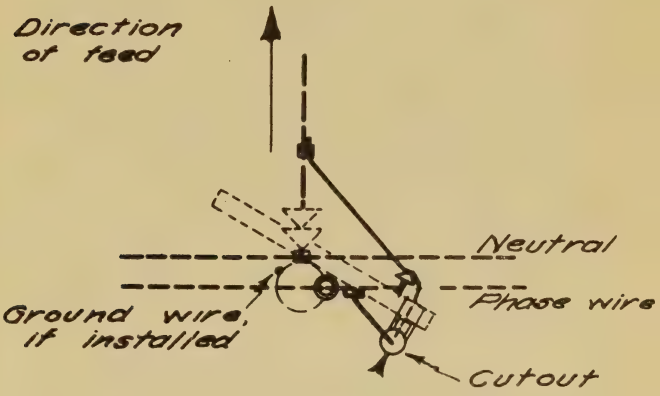
COMPLETELY SELF - PROTECTING TRANSFORMER. SCHEMATIC DIAGRAM OF CONNECTIONS



(Schematic Diagram)

Note:
Jumper from hot line clamp to cutout is well supported on insulators above climbing space.

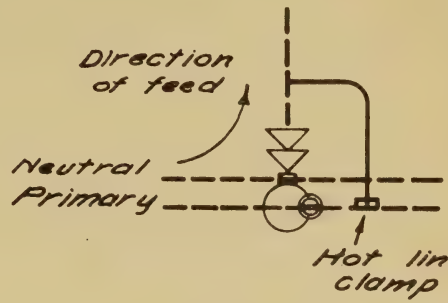
FIG. NO. 8.
INSTALLATION OF CUTOUT ON TANGENT POLE



(Schematic Diagram)

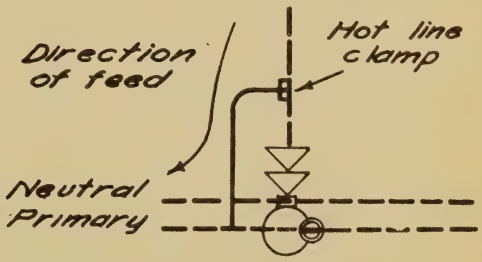
Note:
Hot lead is shortest lead.

FIG. NO. 9
INSTALLATION OF CUTOUT ON TAP POLE



FEEDING INTO SINGLE TAP

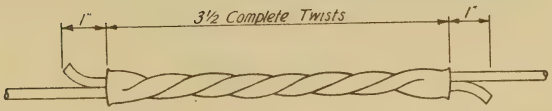
(Schematic Diagrams)



FEEDING INTO TANGENT LINE

FIG. NO. 10

FUNDAMENTALS OF INSTALLATION OF HOT LINE CLAMP



Single Tube, Oval, Copper Sleeve

NOTE -

Before making joint be sure that inside of tube and ends of conductor to be inserted in tube are free from dirt and grease, etc., in other words - perfectly clean.

Splice shall not be within 3 feet from insulator.

For 9½ D, and 3 no. 12 Copperweld strands use same as 8C Copperweld-copper.

For #4 and #6 copper make 4 complete twists.

On stranded conductors each sleeve should be twisted so that its helix is in the opposite direction to the lay of the strand.

SIZE OF CONDUCTOR	NUMBER OF WIRES.	SLEEVE LENGTH, INCHES.	WEIGHT OF SLEEVE, POUNDS.
#1-3 Strand Copper	3	14	.60
#2-3 Strand Copper	3	12.5	.40
#4-Copper Wire	1	7.5	.13
#6-Copper Wire	1	6	.07
#4A Copperweld-Copper	3	11	.31
#6A Copperweld-Copper	3	8.5	.16
#8A Copperweld-Copper	3	7.5	.13
#8C Copperweld-Copper	3	6.75	.11

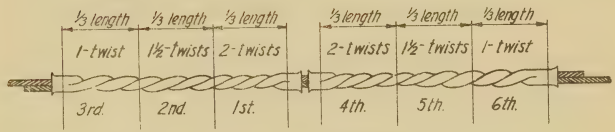
SPLICING GUIDE-OVAL TUBE TYPE
COPPER AND COPPERWELD-COPPER

Scale: N.T.S.

FIG. NO. 11

Date: M45-1

For sizes Nº's 2, 4, and 6



For sizes 1/0 and larger

Give each sleeve 4½ complete twists distributed as shown in sketch. This requires three different settings of the twisting wrenches. Make these in the order shown in the sketch.

At the end of the joint the wrench should not be placed closer than ¼" to the end of the sleeve.

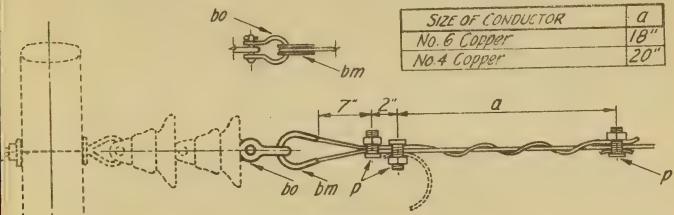
Before making joint be sure that inside of tubes and ends of cable to be inserted in tubes are free from dirt and grease, etc., in other words-perfectly clean.

Splice shall not be within 3 feet from insulator.

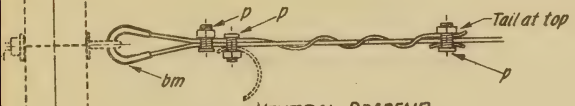
SPLICING GUIDE
A.C.S.R. CONDUCTOR

Scale: N.T.S.	FIG. NO. 12	Date: M45-10

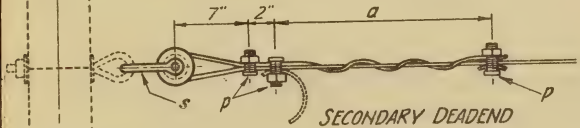
SIZE OF CONDUCTOR	a
No. 6 Copper	18"
No. 4 Copper	20"



PRIMARY DEADEND
ASSEMBLY "ca"



NEUTRAL DEADEND
ASSEMBLY "cb"



SECONDARY DEADEND
ASSEMBLY "cc"

Notes:
1-Line conductors to be in center of connectors for protection as shown.
2-Connectors to be tightened by using two wrenches to avoid kinking conductors.
3-Copper wire shim 2" long at third connector to prevent nicking of conductor.

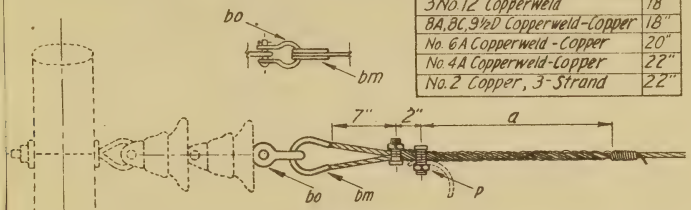
ITEM	No. Req'd	MATERIAL
bm		Thimble, guy, 5/8"
bo		Shackle, anchor

ITEM	No. Req'd	MATERIAL
s		Clevis, secondary, swinging, insulated
p		Connectors, as req'd.

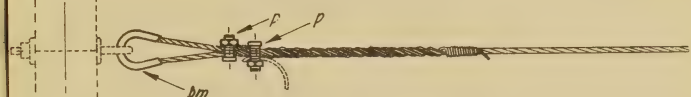
DEADEND ASSEMBLY GUIDE-CONNECTOR METHOD
SOLID COPPER CONDUCTORS

Scale: 1½"=1'-0"	FIG. NO. 13	Date: M42-1

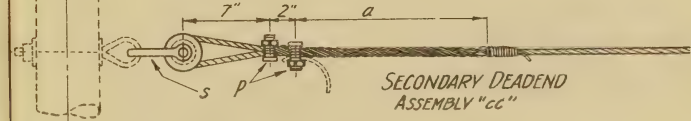
SIZE OF CONDUCTOR	a
3 No. 12 Copperweld	18"
8A, 8C, 9½D Copperweld-Copper	18"
No. 6A Copperweld-Copper	20"
No. 4A Copperweld-Copper	22"
No. 2 Copper, 3-Strand	22"



PRIMARY DEADEND
ASSEMBLY "ca"



NEUTRAL DEADEND
ASSEMBLY "cb"



SECONDARY DEADEND
ASSEMBLY "cc"

Notes:

1- Line conductors to be in center of connectors for protection as shown.
2- Connectors to be tightened by using two wrenches to avoid kinking conductors.
3- Wrap free end of conductor along line conductor, using same lay. Extend one strand of free end (for copperweld-copper this is the copperweld strand) against line conductor. Serve the other two strands six turns each and cut them off. (Always serve copper strand (s) first.) Bend extended strand away from line conductor and cut off.
4- For alternate method of deadending primary and neutral conductors see Drawing M42-3.

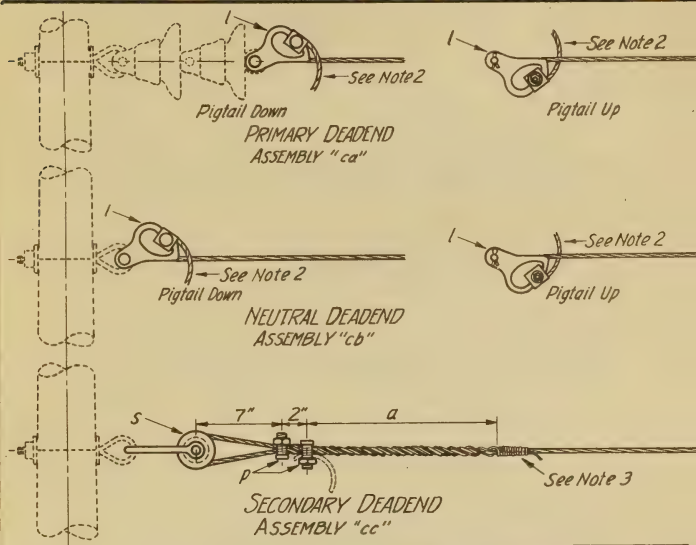
ITEM	MATERIAL	ITEM	MATERIAL
p	Connectors, as req'd	bm	Thimble, guy, 5/8"
s	Clevis, secondary, swinging, insulated	bo	Shackle, anchor

DEADEND ASSEMBLY GUIDE - CONNECTOR METHOD
COPPERWELD - COPPER AND STRANDED COPPER CONDUCTORS

Scale: 1½"-1'-0"

FIG. NO. 14

Date: M42-2



SIZE OF CONDUCTOR	a
No 8 A.S. 6A Copperweld-Copper	18"
No. 4A Copperweld-Copper	20"
No. 2 Copper, 3-strand	22"

Notes:

1- For alternate method of deadending primary and neutral conductors, see Drawing M42-2.

2- Bend pigtail away from line conductor to avoid chafing.

3- Wrap free end of conductor along line conductor, using same lay. Extend one strand of free end (for copperweld-copper this is the copperweld strand) against line conductor. Serve the other two strands six turns each and cut them off. (Always serve copper strand (s) first.) Bend extended strand away from line conductor and cut off.

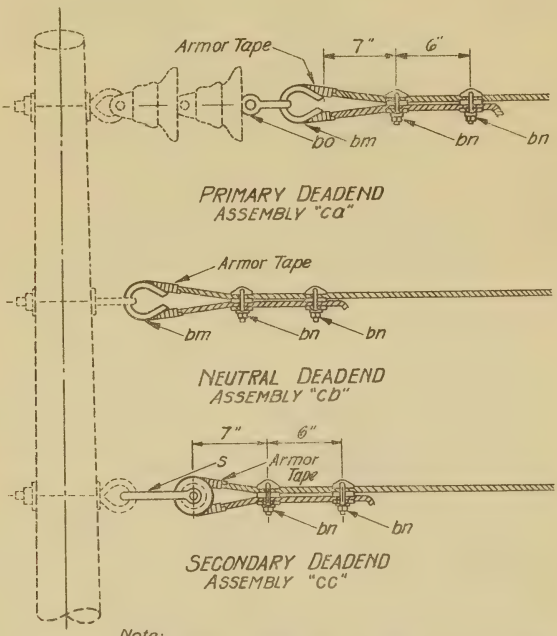
ITEM	No. Req'd.	MATERIAL		ITEM	No. Req'd.	MATERIAL	
l		Clamp, deadend		s		Clevis, secondary, swinging, insulated	
p		Connectors, as req'd.					

DEADEND ASSEMBLY GUIDE-DEADEND CLAMP METHOD
COPPERWELD-COPPER AND STRANDED COPPER CONDUCTORS

Scale: 1½"-1'-0"

FIG. No. 15

Date: M42-3



Note:
For l/o and larger use 3" thimble clevis instead of guy thimble.

ITEM	No. REQ'D.	MATERIAL
bm		Thimble, guy, 3/8"
bn		Clamp, loop deadend
bo		Shackle, anchor

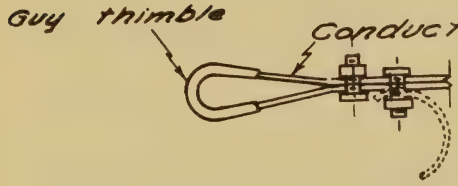
ITEM	No. REQ'D.	MATERIAL
S		Clevis, secondary, swinging, insulated

DEADEND ASSEMBLY GUIDE
A.C.S.R. CONDUCTORS

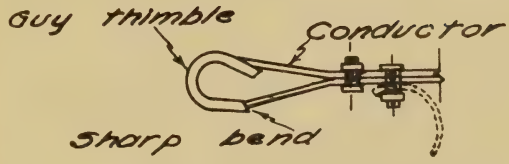
Scale: 1½:10

FIG. No 16

Date: M42-10

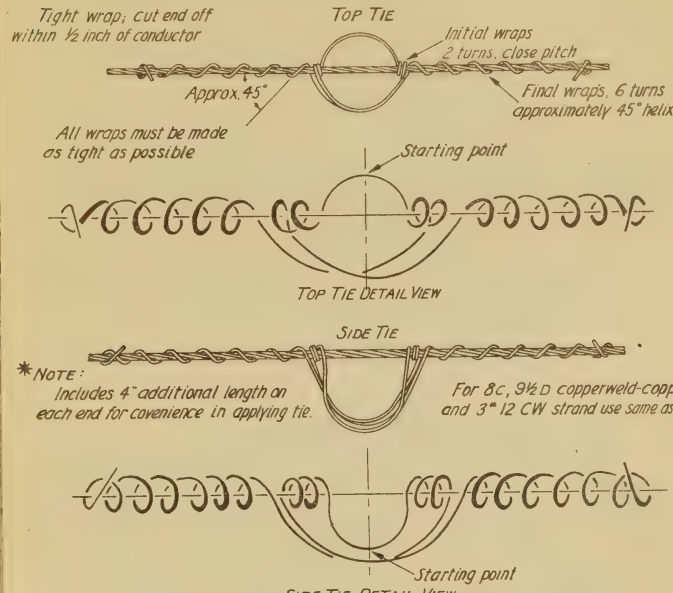


CORRECT METHOD



INCORRECT METHOD

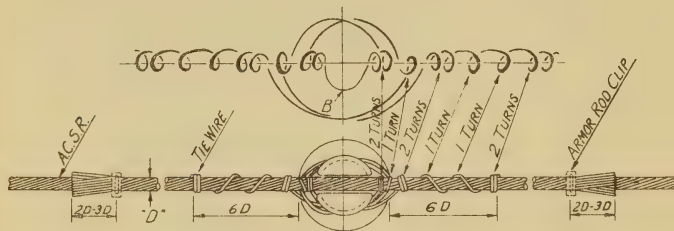
FIG. NO. 17
GUY THIMBLE INSTALLATION
CONNECTOR TYPE DEADEND



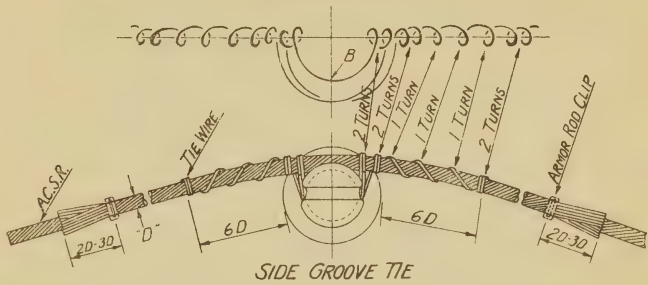
Conductor	Fully Annealed Copper Tie Wire		
	Size of Tie Wire AWG.	Length of Tie Wire Inches *	
		Top Tie	Side Tie.
2 - 3 Strand Copper	4	54	60
4A Copperweld-Copper	6	52	58
4 Copper Wire	6	50	56
6 Copper Wire	8	46	52
6A Copperweld-Copper	8	46	52
8A Copperweld-Copper	8	44	50

Tying Guide, Single Insulator
Copper and Copperweld-Copper

Scale: NTS | Fig. No. 18 | Date M40-1



TOP GROOVE DOUBLE TIE



SIDE GROOVE TIE

NOTE:
Tie wire assembly should be as tight as can be wrapped by hand. In making ties, start with middle of length of tie wire at position marked "B."

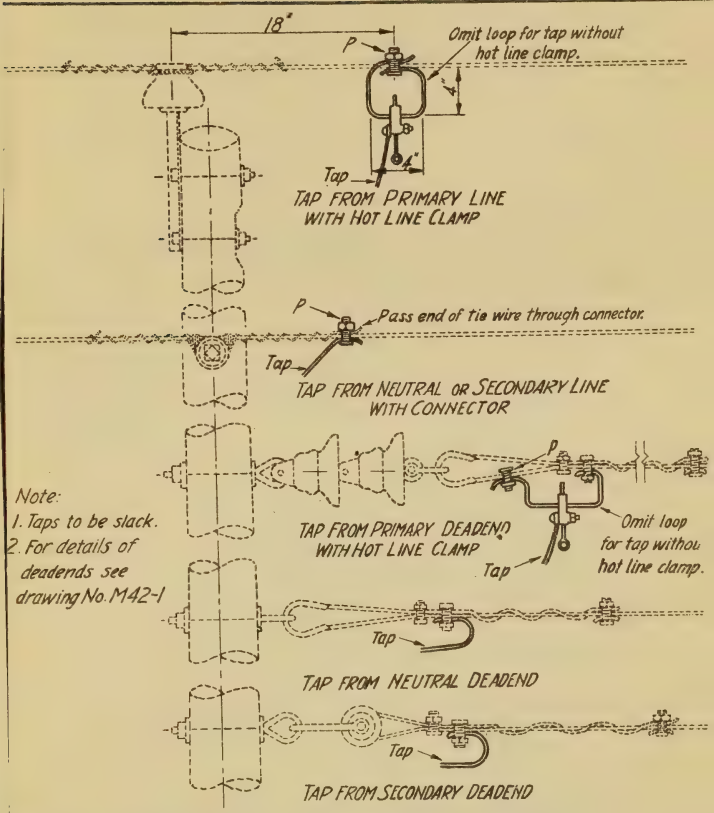
A.C.S.R.		ARMOR RODS	TIE WIRE		A.C.S.R.		ARMOR RODS	TIE WIRE	
SIZE	DIAM. INCHES	"D" DIAM. INCHES	SIZE	LENGTH FEET	SIZE	DIAM. INCHES	"D" DIAM. INCHES	SIZE	LENGTH FEET
1/0	0.398	0.744	4	6.5	4	0.257	0.555	6	5.3
2	0.325	0.595	6	5.6	6	0.198	0.434	6	4.8

TYING GUIDE, SINGLE INSULATOR
A.C.S.R CONDUCTOR

Scale:- N.T.S.

FIG. NO. 19

Date:
M40-10



Note:
1. Taps to be slack.
2. For details of deadends see drawing No. M42-1

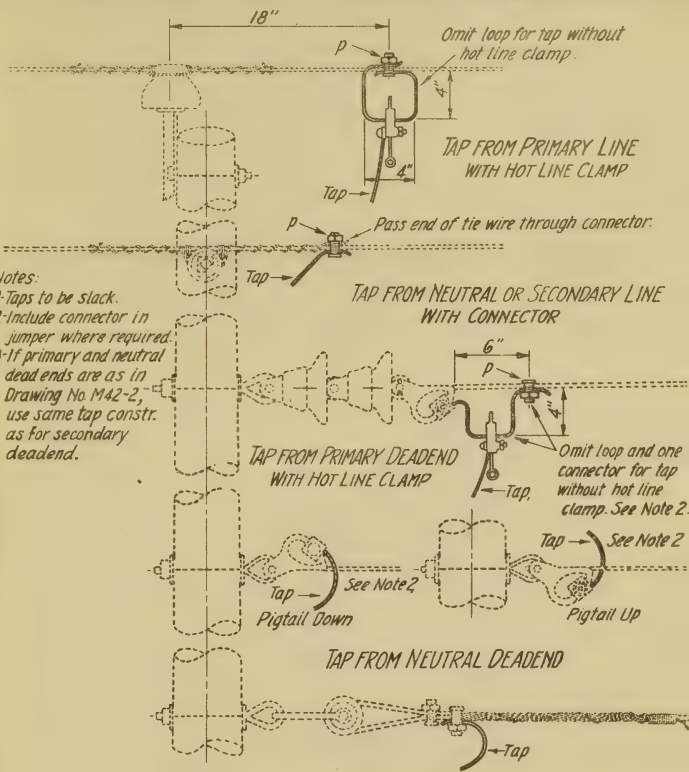
ITEM	No. REQ'D	MATERIAL		ITEM	No. REQ'D	MATERIAL	
P		Connectors, as required					

TAP ASSEMBLY GUIDE
SOLID COPPER CONDUCTORS

Scale: 1½"-1'-0"

FIG. NO. 20

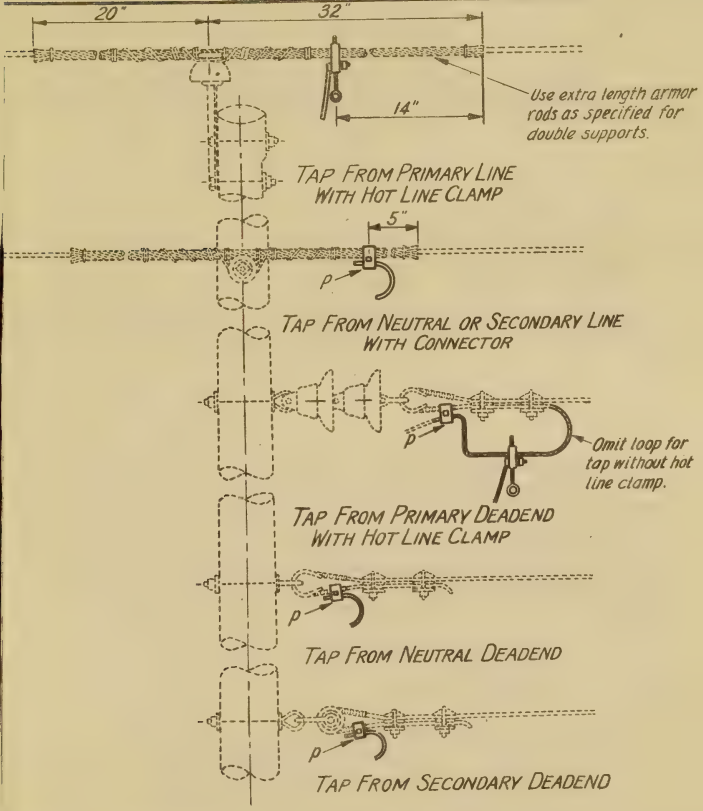
Date: M43-1



ITEM	NO. REQ'D	MATERIAL		ITEM	NO. REQ'D	MATERIAL	
P		Connectors, as req'd.					

TAP ASSEMBLY GUIDE
COPPERWELD-COPPER AND STRANDED COPPER CONDUCTORS

Scale: 1½"=1'-0" | FIG. NO. 21 | Date: M43-2



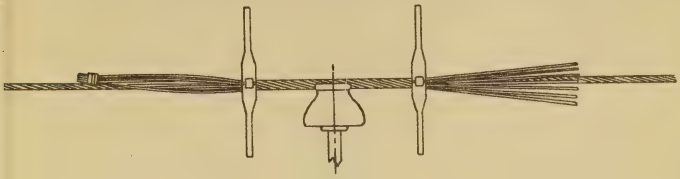
ITEM	No. REQ'D.	MATERIAL	ITEM	No. REQ'D.	MATERIAL
P		Connector (parallel groove clamp)			

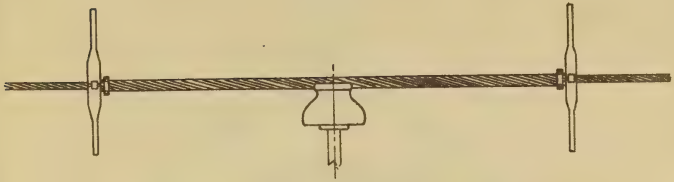
TAP ASSEMBLY GUIDE
A.C.S.R. CONDUCTORS

Scale: 1"=1'-0"

FIG. NO. 22

Date: M43-10





NOTE:

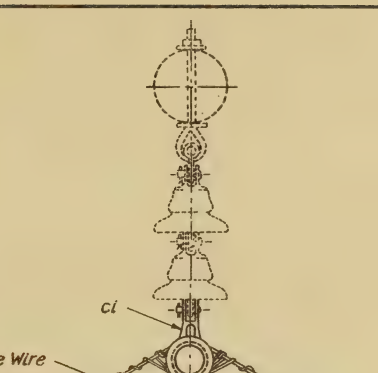
With tape still on one end of rods and other end threaded through wrenches so they open between the same two rods, center on conductor over point of support and close around conductor as shown above. Twist rods enough to give permanent set. Remove tape and slide wrenches half way to ends and repeat. Move wrenches to end of rods and twist. Attach clips and tighten before removing wrenches so ends of rods will flare after removal. Rods should be twisted snugly with a smooth lay in same direction as lay of conductor. For further information and method of installing rods on angle see manufacturer's Suggestions for Construction, A.C.S.R. Rural Lines.

CONDUCTOR SIZE	SUPPORT	
	SINGLE	DOUBLE
	TWISTS	
#6 A.C.S.R. (6Al/1St.)	5-6	7-8
#4 A.C.S.R. (6Al/1St.) & (7Al/1St.)	5-6	7-8
#2 A.C.S.R. (6Al/1St.) & (7Al/1St.)	6-7	8-9
#1/0 A.C.S.R. (6Al/1St.)	4-5	6-7

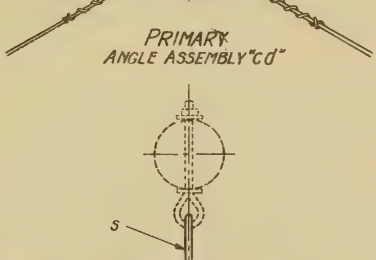
ARMOR RODS
A.C.S.R. CONDUCTOR

Scale: N.T.S

Date: M40-11



PRIMARY
ANGLE ASSEMBLY "cd"



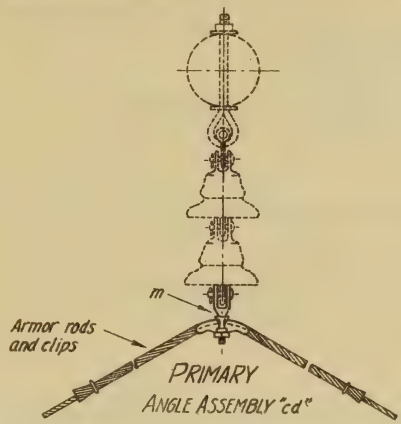
NEUTRAL AND SECONDARY
ANGLE ASSEMBLY "ce"

ITEM	No. 1902	MATERIAL		ITEM	No. 1902	MATERIAL	
s		Clevis, secondary, swinging, insulated					
i		Clevis, thimble, side opening					

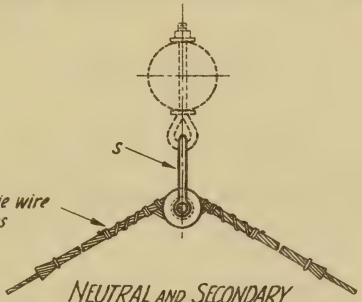
ANGLE ASSEMBLY GUIDE VERTICAL CONSTR. - 30° TO 60° ANGLE
COPPER & COPPERWELD - COPPER CONDUCTORS

Scale: 1½"=1'-0"

Date:
M41-1



PRIMARY
ANGLE ASSEMBLY "cd"



NEUTRAL AND SECONDARY
ANGLE ASSEMBLY "ce"

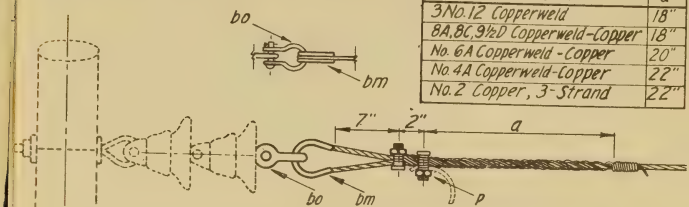
ITEM	No. REQD.	MATERIAL		ITEM	No. REQD.	MATERIAL	
m		Clamp, suspension					
s		Clevis, secondary, swinging, insulated					

ANGLE ASSEMBLY GUIDE, VERTICAL CONSTR.-30° TO 60° ANGLE
A.C.S.R. CONDUCTORS

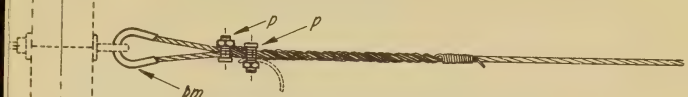
Scale: 1½"-1'-0"

Date: M41-10

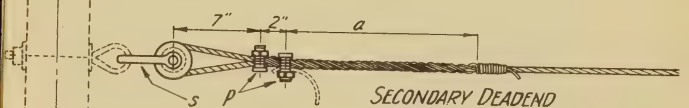
SIZE OF CONDUCTOR	a
3 No. 12 Copperweld	18"
8A, 8C, 9½D Copperweld-Copper	18"
No. 6A Copperweld-Copper	20"
No. 4A Copperweld-Copper	22"
No. 2 Copper, 3-Strand	22"



PRIMARY DEADEND
ASSEMBLY "ca"



NEUTRAL DEADEND
ASSEMBLY "cb"



SECONDARY DEADEND
ASSEMBLY "cc"

Notes:

1- Line conductors to be in center of connectors for protection as shown.
2- Connectors to be tightened by using two wrenches to avoid kinking conductors.
3- Wrap free end of conductor along line conductor, using same lay. Extend one strand of free end (for copperweld-copper this is the copperweld strand) against line conductor. Serve the other two strands six turns each and cut them off. (Always serve copper strand (s) first.) Bend extended strand away from line conductor and cut off.
4- For alternate method of deadending primary and neutral conductors see Drawing M42-3.

ITEM	MATERIAL	ITEM	MATERIAL
p	Connectors, as req'd	bm	Thimble, guy, 5/8"
s	Clevis, secondary, swinging, insulated	bo	Shackle, anchor

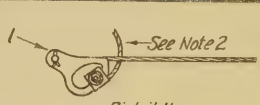
DEADEND ASSEMBLY GUIDE - CONNECTOR METHOD
COPPERWELD - COPPER AND STRANDED COPPER CONDUCTORS

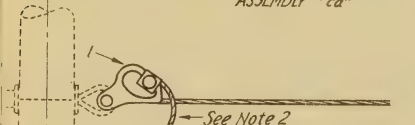
Scale: 1½"=1'-0"

Date:

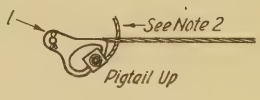
M42-2

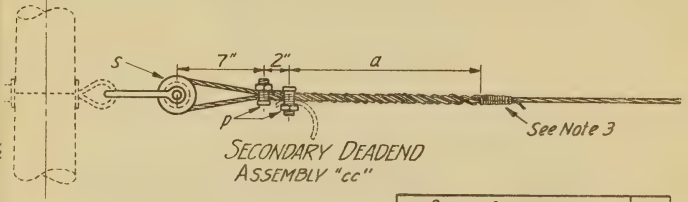
PRIMARY DEADEND
ASSEMBLY "ca"





NEUTRAL DEADEND
ASSEMBLY "cb"





SECONDARY DEADEND
ASSEMBLY "cc"

SIZE OF CONDUCTOR	a
No 8 A & 6 A Copperweld-Copper	18"
No. 4 A Copperweld-Copper	20"
No. 2 Copper, 3-strand	22"

Notes:

1- For alternate method of deadending primary and neutral conductors, see Drawing M42-2.

2- Bend pigtail away from line conductor to avoid chafing.

3- Wrap free end of conductor along line conductor, using same lay. Extend one strand of free end (for copperweld-copper this is the copperweld strand) against line conductor. Serve the other two strands six turns each and cut them off. (Always serve copper strand (s) first.) Bend extended strand away from line conductor and cut off.

ITEM	NO. REQ'D	MATERIAL
		Clamp, deadend
		Connectors, as req'd.

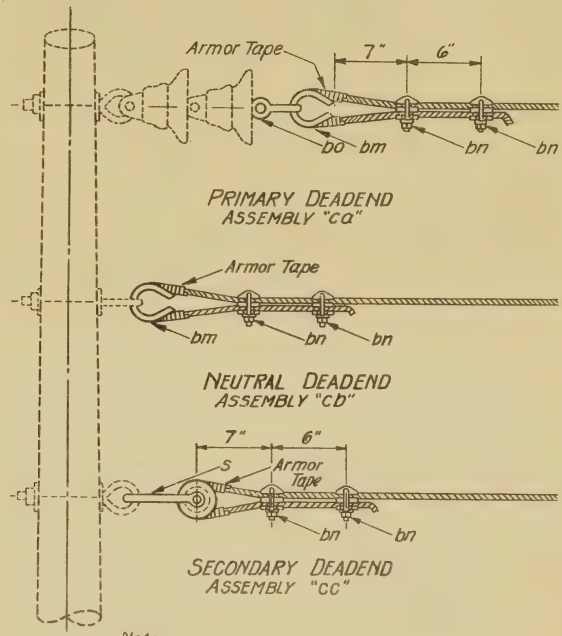
ITEM	NO. REQ'D	MATERIAL
S		Clevis, secondary, swinging, insulated

DEADEND ASSEMBLY GUIDE-DEADEND CLAMP METHOD
COPPERWELD-COPPER AND STRANDED COPPER CONDUCTORS

Scale: 1½"=1'-0"

Date:

M42-3

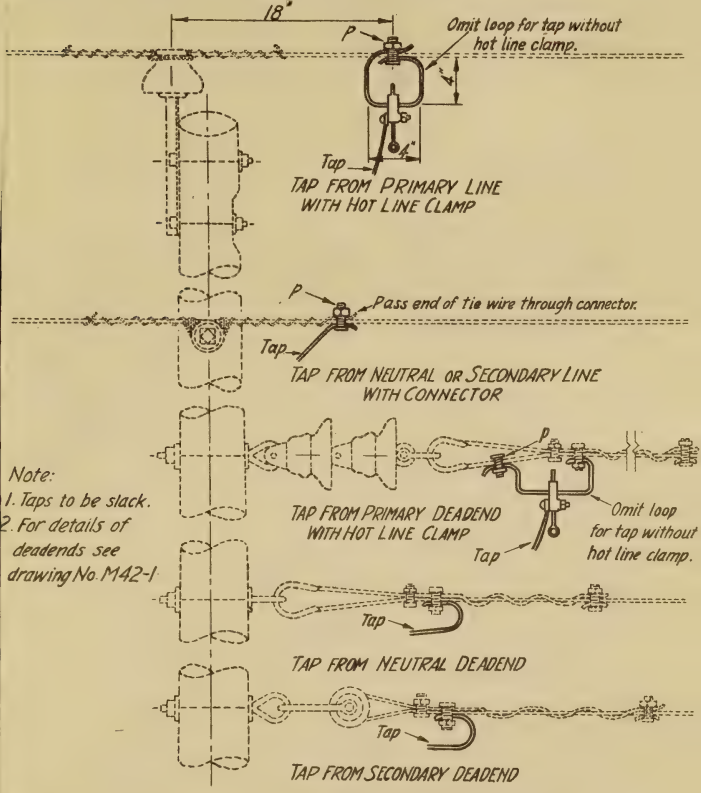


Note:
For 1/0 and larger use 3" thimble clevis instead of guy thimble.

ITEM	No. REQ'D.	MATERIAL		ITEM	No. REQ'D.	MATERIAL	
bm		Thimble, guy, 5/8"		S		Clevis, secondary, swinging, insulated	
bn		Clamp, loop deadend					
bo		Shackle, anchor					

DEADEND ASSEMBLY GUIDE
A.C.S.R. CONDUCTORS

Scale: 1½"=1'-0" | Date: M42-10



Note:
1. Taps to be slack.
2. For details of deadends see drawing No. M42-1

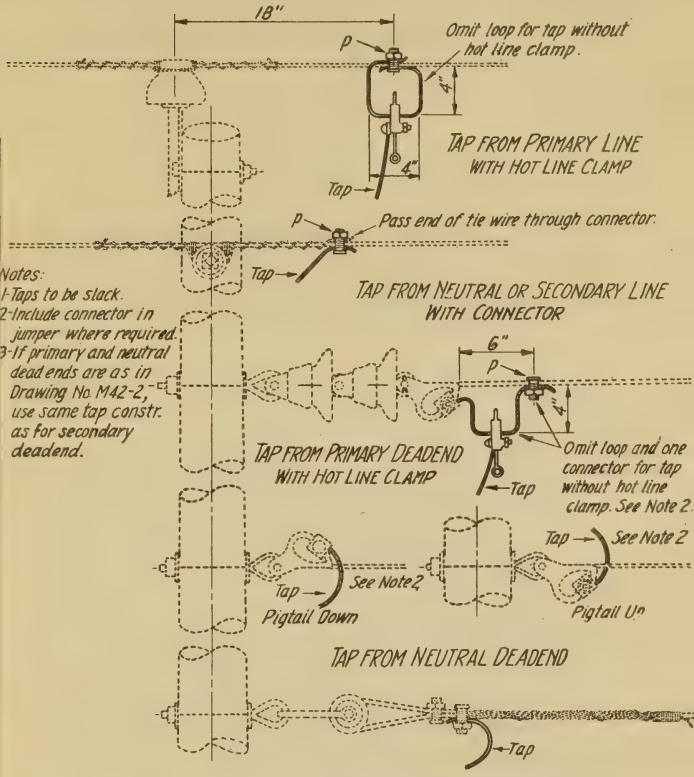
ITEM	No. REQD.	MATERIAL		ITEM	No. REQD.	MATERIAL	
P		Connectors, as required					

TAP ASSEMBLY GUIDE
SOLID COPPER CONDUCTORS

Scale: 1½"=1'-0"

Date:

M43-1



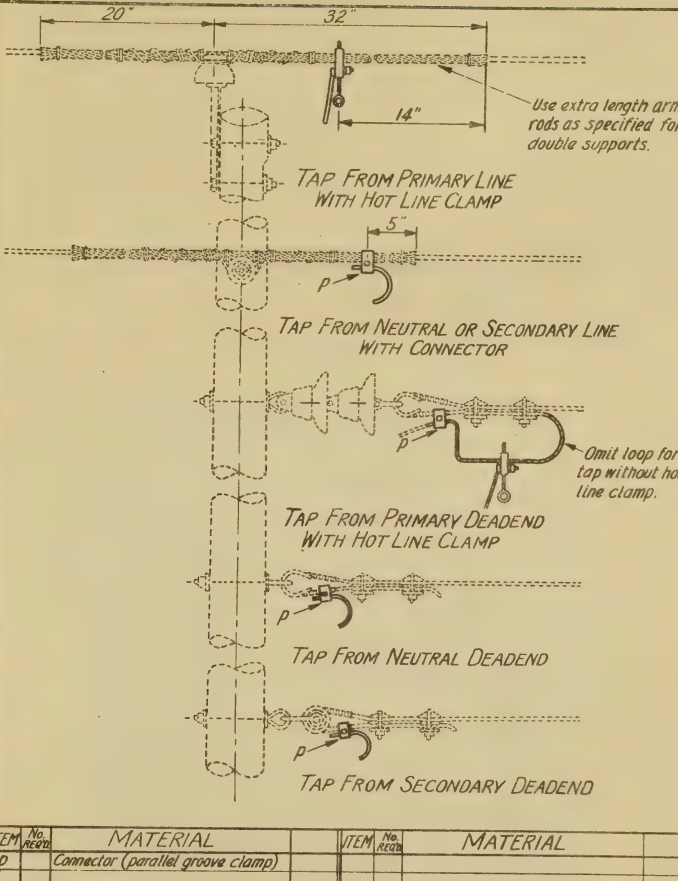
ITEM	NO. REQ'D	MATERIAL		ITEM	NO. REQ'D	MATERIAL
P		Connectors, as req'd.				

TAP ASSEMBLY GUIDE
COPPERWELD-COPPER AND STRANDED COPPER CONDUCTORS

Scale: 1½"=1'-0"

Date:

M43-2

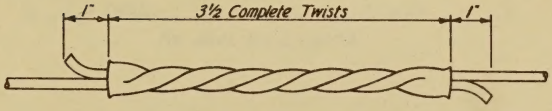


ITEM	No. REQ'D.	MATERIAL	ITEM	No. REQ'D.	MATERIAL
P		Connector (parallel groove clamp)			

TAP ASSEMBLY GUIDE
A.C.S.R. CONDUCTORS

Scale: 1"=1'-0"

Date: M43-10



Single Tube, Oval, Copper Sleeve

NOTE -

Before making joint be sure that inside of tube and ends of conductor to be inserted in tube are free from dirt and grease, etc., in other words - perfectly clean.

Splice shall not be within 3 feet from insulator.

For 9½ D, and 3 no. 12 Copperweld strands use same as 8C Copperweld-copper.
For #4 and #6 copper make 4 complete twists.

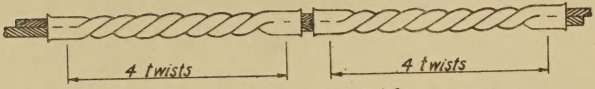
On stranded conductors each sleeve should be twisted so that its helix is in the opposite direction to the lay of the strand.

SIZE OF CONDUCTOR	NUMBER OF WIRES.	SLEEVE LENGTH, INCHES.	WEIGHT OF SLEEVE, POUNDS.
#1-3 Strand Copper	3	14	.60
#2-3 Strand Copper	3	12.5	.40
#4-Copper Wire	1	7.5	.13
#6-Copper Wire	1	6	.07
#4A Copperweld-Copper	3	11	.31
#6A Copperweld-Copper	3	8.5	.16
#8A Copperweld-Copper	3	7.5	.13
#8C Copperweld-Copper	3	6.75	.11

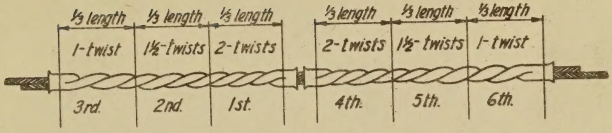
SPLICING GUIDE-OVAL TUBE TYPE
COPPER AND COPPERWELD-COPPER

Scale: N.T.S.

Date: M45-1



For sizes no's 2, 4, and 6



For sizes 1/0 and larger

Give each sleeve 4½ complete twists distributed as shown in sketch. This requires three different settings of the twisting wrenches. Make these in the order shown in the sketch.

At the end of the joint the wrench should not be placed closer than ¼" to the end of the sleeve.

Before making joint be sure that inside of tubes and ends of cable to be inserted in tubes are free from dirt and grease, etc., in other words–perfectly clean.

Splice shall not be within 3 feet from insulator.

SPLICING GUIDE
A.C.S.R. CONDUCTOR

Scale: N.T.S.

Date:
M45-10